2020

Introducing Our 2020 Seed Projects

NPS Alumni Association & Foundation

Monterey, California; Naval Postgraduate School

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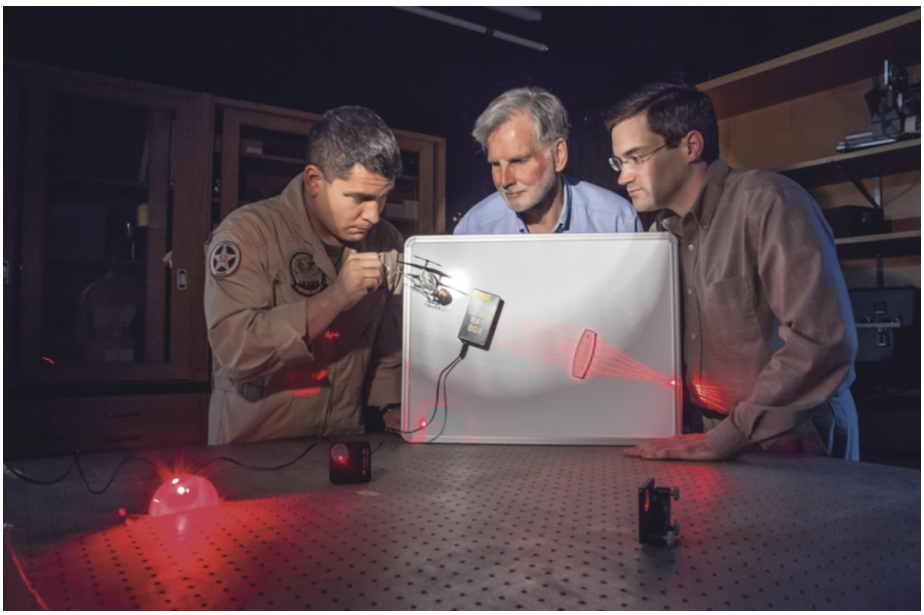

Thanks for our Defense Innovation Fund's Seed Program, eight new research projects at the Naval Postgraduate School (NPS) are receiving seed funding to continue developing their ideas. The NPS Alumni Association & Foundation Seed Program exists to provide initial capital for research that improves national security and war-fighting capabilities through a competitive, venture capital funding model.

Accepted projects move through three phases of funding:

Phase one: Open call for research proposals

Phase two: Selected projects receive $10,000 each to develop a detailed plan

Phase three: Selected projects receive additional funding to complete research

Here are the eight projects, led by NPS faculty, that we recently selected to receive phase one seed funding in 2020:

- **Using Data-Limited Mesh Networks to Create a Realistic, Distributed LVC Training Environment at the Small-Unit Level:** Since the development of simulation interoperability standards in the 1990s, the U.S. Navy and Marine Corps have been networking various combat simulations to create live virtual constructive (LVC) training environments that attempt to simulate the "fog of war" expected on today's modern battlefield. In theory, using constructive simulations during live training events to stimulate command and control systems allows operational units to train against agile enemies in a more realistic environment. Creating such an environment is data-intensive and challenging when using distributed radio frequency (RF) networks. This research seeks to create a methodology to pass data efficiently across RF mesh networks to create more realistic training events for our sailors and marines at the small-unit level. This methodology could be applied to various software defined radios (SDRs) in tactical unit inventories. Lead researcher: Dr. Imre Balogh, research associate professor and director of the MOVES Institute

- **AI, Human and Teams: Allocation of Decision Task in Complex Situations:** The accelerating proliferation of human machine teaming (HMT) in the command and control (C2) context, offers new opportunities and can accentuate potential threats in the observe, orient, decide, and act (OODA) loop. Performance of an HMT depends on the effective interdependency among humans and machines. A 2019 report from the Center for Naval Analysis indicates that HMTs can outperform human- or machine-only teams. However, the same study specifies that depending on the decision step of the OODA loop, the outperforming member type varies. For example, machines dominate observe and act steps, and humans dominate the orient step. In the decision step, the dominating member type varies depending on risk tolerance as constrained by the perplexities of the environment. The purpose of this study is to develop a theoretical and practical framework to guide the approach for a best fit team member focus on the aspects of the OODA loop C2 process that reflects their relative expertise. Lead researcher: Dr. Anthony Mustafa Canan, assistant professor

- **Establishment of World-Ocean Acoustic and Thermohaline Parameter Database:** We will establish a world-wide acoustic and thermohaline parameter database from observational temperature and salinity profiles (more than 10 million profiles). The parameters include sonic layer depth, sound channel axis, critical depth, isothermal (isohaline) layer depth, thermocline (halocline) gradient, isothermal (isohaline) layer heat (salinity) content, sea surface temperature (salinity), and temperature (salinity) below isothermal layer. Such datasets do not

exist in scientific and naval communities and the proposed database would be very useful for undersea warfare. Lead researcher: Dr. Peter Chu, distinguished professor and chair of Department of Oceanography

- **Creating a U.S. Navy Practical Experimentation Guide:** There has been a resurgence of interest in experimentation across the U.S. Navy. However, there is a difference in understanding what experimentation is, how it is conducted, and what it produces among various organizations. There is no one resource for how to do the work of experimentation. This NPS team has developed expertise in experimentation; taking an idea and working it all the way through via an experimentation plan, methodology, data collection, analysis, and reporting. This project will create a new guide to help officers understand the work of experiment planning at the deck plate level. It details tasks and coordinates requirements. Experimentation will thus become more consistent and relevant navy-wide. Lead researchers: Dr. Shelly Gallup, research associate professor and Brian Wood, research associate

- **3D Printing Superhydrophobic Ceramic Surfaces:** The objective of this seed project is to develop approaches for the 3D printing of ceramics with superhydrophobic characteristics directly onto metal surfaces. A recent study by the Government Accountability Office (GAO) estimated the cost due to corrosion to the Department of Defense (DoD) was $21 billion per year. With the ascension of additive manufacturing, potential avenues for corrosion prevention have opened. It is now possible to print metal parts with complex geometries and, after post-processing, install the parts without having to wait on suppliers. Could the U.S. Navy also print directly onto those parts a superhydrophobic ceramic coating which will protect that part from corrosion? If a sailor can print a metal part and the protective surface all while on a ship, the cost savings for the navy and DoD could be substantial. Lead researcher: Dr. Troy Ansell, research assistant professor and Dr. Andy Nieto, assistant professor

- **Synthesis of Nanostructured High Entropy Alloys via Cryogenic Mechanical Alloying:** The objective of this seed project is to develop structural metals with high strength and exceptional corrosion and wear resistance. High entropy alloys (HEA) are metal alloys consisting of five or more elemental metals. The development of nanostructured HEA material would represent a leap ahead in technology for the U.S. Navy due to the predicted high strength and exceptional wear and corrosion resistance of these materials. Lead researcher: Dr. Andy Nieto, assistant professor

- **Evidence of Media Effects Theory in Cyberspace:** No research to date has used statistical methods on real-world cyber intrusion data to test a conjectured relationship between some exogenous catalyst(s) (i.e. media narratives and cyber intrusion activity). For example, could diplomatic tension between the United States and Iran be driving the number of intrusions on U.S. servers? Some evidence exists that cyber intrusion activity may be motivated by the level of political cooperation or conflict between sovereign nations. The objective of this project is to develop a causal inference model between media narratives today and cyber intrusions tomorrow, which could allow information technology professionals to develop indicators and warnings of impending threats to U.S.-based networks. Lead researcher: Mitch McCarthy, lecturer

- **Impact of Technology and Automation on Occupations in the U.S. Navy and Marine Corps:** The principle output of this research is developing credible conclusions regarding the impact of technology and automation on occupations in the U.S. Navy and Marine Corps. There appears to be wide-spread popular and professional concern about the impact of technology and automation on jobs, employment, and wages in the U.S. Automation, often anthropomorphized as "robots," and "artificial intelligence" have received considerable attention. The predictions about the potential loss of jobs in the U.S. economy in the next few decades are alarming indeed in that they range from 10-15 percent at the low end to 40-50 percent at the high end. This impact of technology and automation on occupations in the civilian part of the economy is likely to be mirrored in the military. Lead researcher: Dr. Uday Apte, distinguished professor

The Seed Program is continuing to fuel more innovative research each year, and there are more projects seeking full funding. To learn more, visit **npsfoundation.org/defense-innovation**.

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